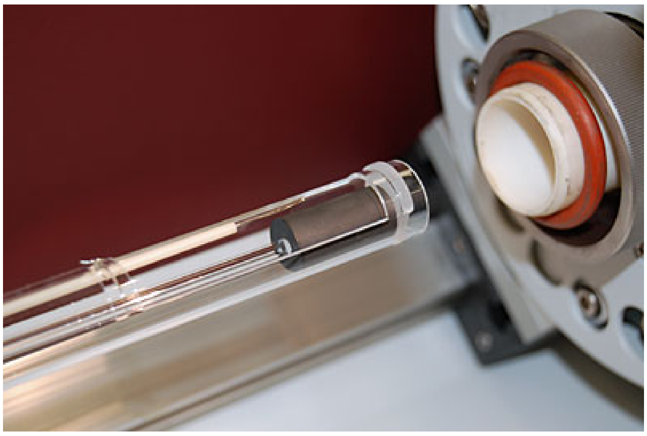
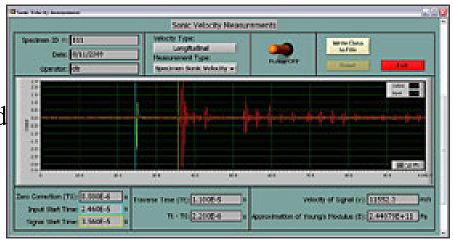


INL's Carbon Characterization Lab tests the properties and behavior of graphite, a key component of many current and future nuclear reactors.

INL facility a world leader in nuclear graphite testing

By Mike Wall, *INL Research Communications Fellow*

In early September, scientists at Idaho National Laboratory slid a 14-foot-long metallic experiment capsule into place at INL's Advanced Test Reactor, sealed things up, and turned on the juice. The experiment tube holds hundreds of thumbtack-sized graphite samples, which the ATR will blast with intense heat and neutron radiation for the next 18 months. This experiment is one of the first steps in the ambitious new Advanced Graphite Capsule project (AGC), which seeks to understand how graphite will behave in the cores of future nuclear reactors.

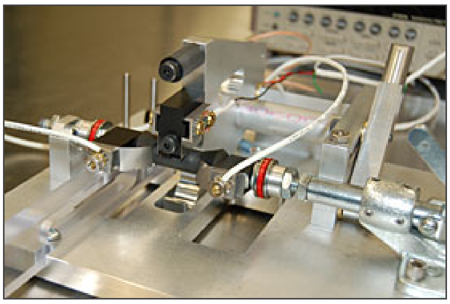


The CCL blasts graphite samples with sound waves to measure the material's stiffness.

Key to the success of the AGC project is INL's new Carbon Characterization Lab, one of the world's most advanced graphite-testing facilities. The CCL, along with Oak Ridge National Laboratory's Low Activation Materials Design and Analysis lab (LAMDA), will characterize and analyze the AGC's irradiated graphite samples, testing their properties and behavior both before and after their trial by fire in the ATR. The CCL's work — on this and many other experiments — will help maximize the efficiency and safety of tomorrow's reactors, one graphite sample at a time.

Graphite a core component

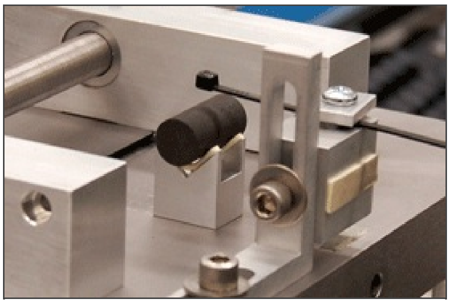
Graphite plays a key role in many current and future reactor designs. Most of the United Kingdom's commercial power plants, for example, use graphite to moderate fission processes (that is, slow neutrons down enough to sustain a chain reaction). The INL-led Next Generation Nuclear Plant (NGNP) and other proposed high-temperature, gas-cooled reactors would be similarly graphite-moderated. They would also use graphite, which has a huge heat-absorbing capacity, to keep nuclear fuel at safe temperatures during unexpected events.



CCL scientists measure graphite's electrical resistivity to learn details about its structure.

But not all graphite is created equal. Different sources, different processing methods and different microstructures can all impact the material's properties and behavior, which in turn can affect how graphite performs inside a reactor. This is where the CCL comes in. It assesses different graphite samples, investigating their structure and how they respond to extreme heat, mechanical stress and neutron irradiation.

Only a handful of facilities on the planet are capable of doing such work, but INL's abilities are unique even within this select group. The CCL has set up an automated system that gives every graphite sample a unique identification number, then tracks each one through all rounds of testing and analysis. So all important information — where each piece of graphite came from, how it was machined, what tests it underwent and the results of those tests — drops directly into a database, eliminating the possibility of data-entry error and ensuring accuracy. The database also gives collaborators around the world quick access to the data generated at INL.



Striking a graphite specimen helps CCL researchers determine how it holds up under severe mechanical stress.

"This is a complete, uninterrupted, cradle-to-grave tracking system," says INL researcher Will Windes, head of the CCL. "I don't think you see this level of rigor top to bottom at other institutions."

The CCL's characterization capabilities help position INL atop the graphite-testing field. Unlike other facilities, INL can now do everything in-house, irradiating samples in the ATR — one of the world's most versatile research reactors — and analyzing results at the CCL.

"It's a real one-two punch," Windes says.

The Advanced Graphite Capsule experiment and beyond

The CCL began operating about 18 months ago. Its chief task is to characterize more than 3,000 graphite samples for the AGC, which is looking at graphite specifically for use in the proposed

NGNP. This work will keep the CCL and Oak Ridge's LAMDA facility busy for the next decade. It will take that long for the six different AGC experiments to work their way through the ATR and all the various characterization steps. But the CCL can also take on other projects at the same time, and there is no shortage of potential collaborators.

"We've had lots of people interested in coming over and using our facilities," Windes says.

INL can do all its graphite-characterization work in-house: irradiate samples in the ATR, then analyze them at the CCL.

For example, Windes is teaming with researchers from Boise State University and the University of Manchester in England to try to figure out the mechanisms behind the mysterious phenomenon of irradiation creep. Creep describes the way graphite strains and shifts in response to high radiation levels, absorbing serious stresses without incurring serious damage.

Creep helps graphite weather the extreme environment of a reactor core, but nobody is quite sure how it works. Windes and his team will use the CCL in an attempt to find out. The project illustrates the CCL's potential to contribute to basic — as well as applied — science, and its promise as a new teaching, training and research hub.

"We can build a center of expertise in the field of nuclear graphite at INL," Windes says. "We're here to bring in as many experts as possible, and to train the next generation."

Feature Archive